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AUTHOR Atkins, Debbie; And Others
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ABSTRACT

This paper presents the evaluation results of the "Exploring with Technology" grant funded during the 1992-1993 school year by the Florida Department of Education. The grant proposed to integrate a variety of technological applications with the social studies curriculum. The main purpose of the paper is to discuss the process evaluation of the implementation. Topics covered are the project description; the specific grant components; a literature review; the evaluation plan; the data collection strategies; the summary of findings by evaluation questions (both the processes and the outcomes); and conclusions and recommendations. (Contains 8 references.) (JLB)

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Integrating Technology in the Classroom:

Process Evaluation, Strategies and Issues

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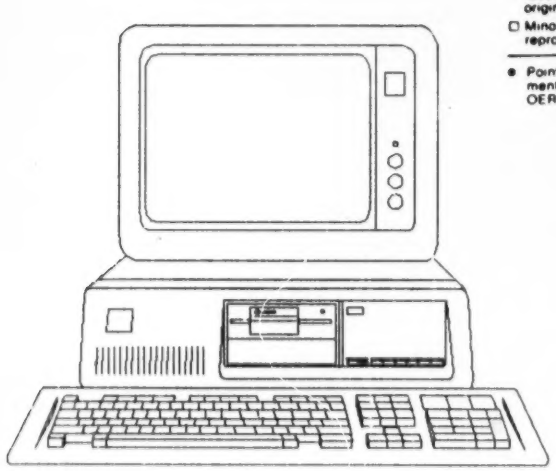

Debbie Atkins
John Green, Ph.D.
Margarida F. Southard, Ph.D.

Leon County Schools
Division of Program Monitoring
and Evaluation Services
Tallahassee, Florida

Paper presented at the 1993 Annual Meeting of the American Evaluation Association
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Integrating Technology in the Classroom:
Process Evaluation, Strategies and Issues

As we approach the 21st century, computer technology, multi-media and electronic networks are being integrated in the classroom throughout the country. Today's technology offers powerful tools for transforming the way we operate our schools.

In 1990, the Florida Legislature established the Instructional Technology Grant Program for implementing state-of-the-art instructional technology in the classroom. Instructional technology was defined as the application of electronic media to the learning process.

Leon County Schools, a middle size school district in north Florida, was awarded approximately $300,000 to introduce and expand the use of instructional technology in the classroom. Specifically, various combinations of electronic media (hardware and software) were introduced in the classroom and used to prepare, motivate and teach a variety of curricula.

Purpose

The purpose of this paper is to present the evaluation results of the Leon County Schools' "Exploring With Technology" grant funded during the 1992-1993 school year by the Florida Department of Education. The grant proposed to integrate a variety of technological applications with Social Studies curriculum.

The main focus of the paper will be on the process evaluation of the implementation. The evaluation of project outcomes in terms of student achievement was considered preliminary because of delays in equipment deliveries and installations. Funds were granted for one year and a complete evaluation report is being finalized.

Specifically, this paper will: (1) describe the evaluation strategies proposed in the grant, (2) briefly review some of the literature related to the evaluation of technologies in the classroom, (3) report the evaluation results of the project implementation, (4) briefly review the results of the specific outcomes proposed in the grant, and (5) discuss the issues and lessons learned during the project's first year of implementation. The lessons are presented in the form of recommended guidelines schools and school districts should incorporate when planning to introduce a wide-range of technologies in classrooms.

Project Description

Fifth-grade students in ten elementary schools in Leon, County Florida participated in a year long study during the 1992-1993 school year. The Exploring with Technology project provided for networking fifth grade classrooms to increase access to telecommunications and related media for both teachers and students. In total 1,043 students were served in 36 classrooms.

Specific Grant Components

- **Purpose and Vision of the Grant.** To empower the students to discover yesterday, explore today, and envision tomorrow through the use of technology. The ultimate purpose was quite ambitious: to better prepare students for a competitive, technological world.

- **Curriculum.** The exploration thematic unit of the 5th grade Social Studies Curriculum and State Student Performance Standards provided the framework for developing the fifteen social studies objectives representing three goal areas. Beginning with the voyage of Columbus, students gather information from telecommunications networks, online information services, video discs and electronic mail about early explorers and pioneers. As students progress in their knowledge of early explorers and experience with communications technologies, their studies progress to today's world. As students make connections among the factors of communication, exploration, technology and change, they will use their enhanced higher order thinking skills to project how these factors come into play in the world of their future.

- **Objectives and Instructional Strategies.** To accomplish the instructional objectives, several suggested instructional strategies and media activities were proposed in the grant. Teachers were required to accomplish instruction in some objectives and were free to select other objectives if they wished. Appendix 1 displays the list of goals, objectives, and instructional strategies and timelines. These form the basis for the evaluation objectives proposed for the grant.

- **Mentor Teachers.** One teacher at each school was designated the mentor teacher to provide training and support as well as model effective use of the technology for other project teachers.

- **Hardware.** Each school was to receive a basic level of technology. Three project teachers at each school were to be provided with a computer and printer to keep in their classroom. In addition, each school was to be provided with a multimedia cart with videodisc player, monitor, CD-Rom, LCD overhead panel, scanner and a computer with desktop publishing capabilities. The media centers were to be provided with a fax machine, a net modem and a CD-Rom Drive.

- **Networks.** Project classrooms in the same school were to be networked. Four schools already had file servers and Netway gateways prior to the grant. Four schools were to receive the complete Novell network with the MAC NLM and two schools were to receive the Novell network without the MAC NLM.

- **Communications.** All project classrooms were to be equipped with telephone lines and free access to online services - such as FIRN, InterNet, and electronic mail. In addition schools were provided funds to access commercial services such as Prodigy and CompuServe.

- **Software.** Schools were to receive funds to purchase software for communications, hypermedia and word processing as well as laser discs and compact disks.

- **Training.** All teachers were to receive at least 44 hours of training in the project technologies. Mentor teachers were to receive an additional nine hours.

- **Personnel.** Funds were granted to provide a project manager to administer the acquisition, distribution, and installation of various technology and curriculum materials, assist with planning and scheduling training sessions, and facilitate project sharing. In addition, a part-time evaluator was dedicated to this project. No funds were allocated to provide for technicians dedicated to the project.

- **Evaluation.** The main focus of the evaluation was to document and monitor project implementation through site visits. Because of uncertainty about what outcomes should be expected, behavioral objectives were not proposed in the grant. The outcomes were formulated in terms of students' products and activities involving the use of a variety of media. The evaluation plan is explained in more detail in the next section.

In summary, the project was innovative in that it approaches the usual fifth grade Social Studies Curriculum from a multimedia perspective. Some of these media are fairly new, and the users themselves have limited experience with them. Furthermore, the instructional environment is distinct from the computer-assisted instructional programs in the 1960s and 1970s and the more recent applications of Integrated Learning Systems (Computer Curriculum Corporation (C.C.C.), WICAT I.L.S. system, Jostens, etc.).

Evaluation of Instructional Technology Programs: Lessons Learned from the Literature

The majority of evaluation studies involving the use of media in the classroom compared instructional outcomes for various media. Research reviews on using computers in instruction (Jamison, Suppes, and Wells, 1974; Kulik and Kulik, 1987; Becker, 1987; Robyler, Castine, and King, 1988) have concluded that computer-assisted instructional programs in the 1960s and 1970s were generally more effective in raising students' scores on standardized achievement tests than alternative approaches.

On the other hand, Reeves (1989) contends that if the purpose of evaluation is to provide information for decision making that will improve the quality of life, a decade of evaluations of interactive multi-media (IMM) did little to promote the use of IMM in higher education or any other level. The vast number of these studies have been media comparisons studies seeking to find differences between IMM and another method of instruction. The bottom line for many of these studies has been "no significant differences" in effectiveness among the media under comparison.

Becker (1987) pointed out that the existing literature about the effectiveness of computer instruction is outdated and suffers from methodological problems. He concluded that "existing evidence of computer effectiveness is scanty, and existing studies provide little guidance for schools to decide how to use computers for instruction". Furthermore, although the media comparison literature is extensive, it does not yet address the complexities of a program in the public schools such as **Exploring With Technology** (Atkins & Green,1993).

Reeves (1989) stated that instructional technology suffers from a lack of fundamental work at the description level and that a multi-faceted approach to evaluation including the conduct of intensive case studies (Stake, 1978) should be adopted.

Far to often program evaluation involving the use of media is limited to an activity that takes place at the conclusion of a program and involves the use of experimental and quasi-experimental designs to compare program outcomes. While this is certainly important it represents only one role of evaluation. If we are to make informed decisions and sound judgements about educational programs, especially those programs that incorporate technology, we must adopt an evaluation approach emphasizing a rich description (Reeves, 1990).

Atkins & Green, 1993 pointed out that in media-rich environments evaluators face some keen challenges in making judgements about program implementation and outcomes. They concluded that "factors that make the judgements difficult include freedom and variance in the use of the complex combinations of media, variance in the skills of the teachers and students, variance in the attributes of the schools' support staff and equipment, and often, profound lack of understanding of the capabilities of the new technology being introduced".

To date there is no body of research or evaluation on the implementation and effectiveness of programs using a variety of technologies. We simply do not know what the program is supposed to be doing. Program evaluation is needed to help us understand the implementation of these programs.

Evaluation Plan

The strategy used in the grant combine elements of formative and summative evaluation. During the implementation of the project, activities were formative and the evaluation focus was on the continuous monitoring of project implementation and on the need for revisions.

The purpose of the summative evaluation was to document to the program staff, the Florida Department of Education (DOE), and potential funding agencies the level of implementation of the project and the results of the evaluation of the specific outcomes included in the grant proposal.

The information in Table 1 presents the evaluation questions and respective data collection procedures proposed in the grant.

The expected outcomes proposed in the grant address students' technological products and achievement, student attendance, attitudes of students, teachers and parents and completion of training (see Table 2).

Data Collection Strategies

1. Site Visits

The main strategy for data collection of program implementation were the site visits.

Each of the ten school site projects was visited three times during the year (October, February and May) by a team consisting of evaluation and instructional specialists. The purpose of the visits was to qualitatively analyze the utilization of the technology, to assess the difficulties and successes during the implementation, and to document the effects (intended and unintended). Formative evaluation reports were provided as feedback for the stakeholders a few weeks after the visits were completed. Some of the areas the team focused on were the changes in the classroom environment, integration of the technology in the daily instruction, teacher needs for training, roles of the media specialist, and availability and use of equipment. The visits were arranged in advance to accommodate the teachers' planning period. Each visit lasted approximately three hours. Following is a brief description of instruments used in each visit.

October Visit

The purpose of this first visit was to establish some baseline information and to get acquainted with the staff at each school. The instruments used were:

- School Official's Interview Form - This instrument was responded to orally.
- Media Specialist's Interview Form. This instrument contained the questions for an interview but could also be administered as a written survey.
- Teachers's Survey Form - This instrument asked questions about hardware use in the teachers classroom.

TABLE 1

EVALUATION QUESTIONS AND DATA COLLECTION PROCEDURES

	EVALUATION QUESTIONS RELATED TO PROCESS	DATA COLLECTION PROCEDURES
1.	Which technologies are available in each classroom?	Site visits, project reports, and observation.
2.	What was the degree of use of the computer workstations and other media such as videodiscs, LCD, overhead panel, CD ROMS and telecommunication applications?	Site visits, teachers' logs, interviews with teachers and media specialists.
3.	Did the use of the media increase during the school year?	Teachers' logs and surveys.
4.	What parts of the grant lacked implementation?	Interviews, staff reports and logs.
5.	How did the technology change the classroom environment and the total school?	On-site observation, interviews with principals, teachers, and media specialists.
6.	What were the perceptions/feelings toward the project?	Interviews with teachers, principals, media specialists, and site visits.
7.	Were teachers able to complete the goals/objectives of the grant?	Teachers' logs, students' products, and interviews.
8.	Was the amount of training sufficient to incorporate appropriately the technology in the classroom?	
	EVALUATION QUESTIONS RELATED TO OUTCOMES	
9.	To what extent were the student outcomes achieved?	Standardized achievement test, products and portfolios. ** See Table 2 for a list of specific student outcomes and evaluation procedures.
10.	Was there a change in the level of student involvement in the school as measured by attendance data?	Attendance records for 1991-92 and 1992-93.
11.	Are the attitude of students, parents and teachers more positive than their counterparts in matched schools?	Attitude survey responses.
12.	What were the major benefits associated with the project?	Overall evaluation measures.

TABLE 2
EXPECTED STUDENT OUTCOMES

	OBJECTIVES	EVALUATION PROCEDURE/SOURCE OF DATA
1.	At least 30% of the fifth grade students enrolled in the project will show an improvement in the area of Reference and Study skills as measured by the Comprehensive Assessment Program (CAP) administered by the district. (Goal I)	Reference and study skills subtest scores. NOTE: This goal was not evaluated due to a change in the test by the District.
2.	At least 90% of the fifth grade students who use the timeline software will be able to chart at least five events in Columbus and other explorers lives as evidenced by students' products. (Goal 1)	Evidence of product in portfolio and/or teacher's log documentation.
3.	At least 40% of the fifth grade students who use communications technologies (bulletin boards, electronic mail, fax) will be able to demonstrate their use by surveying at least five students on their understanding of Columbus and other explorers. (Goal 1)	Documentation of accomplishment in teacher's logs; interview with teacher and students.
4.	At least 30% of the fifth grade students using the computer for writing activities will increase their scores on the CAP language subtest. (Goal 2)	NOTE: Due to a change in tests, longitudinal evaluation of student achievement was replaced with a comparison of students in matched schools.
5.	At least 40% of the fifth grade students enrolled in the project will demonstrate knowledge of today's technology use by producing two posters comparing a technology of today with a technology with a similar purpose used during the time of Columbus. (Goal 2)	Students' posters or documentation.
6.	At least 15% of the fifth grade students enrolled in the project will use electronic mail or fax to enhance a simulation of a modern day exploration as evidenced by teacher reports. (Goal 2)	Teachers' logs.
7.	At least 80% of the fifth grade students participating in the project will contribute a graphic to a class computer slide show reflecting a futuristic vision of advances in communication technologies as evidenced by teacher reports. (Goal 3)	Teachers' logs.
8.	At the end of the year all fifth grade students participating in the project will have a portfolio which will include one sample of a written project generated through technology, a sample of a favorite product, and a log (Sailor's Log documenting their experiences with the technology). (Goal 3)	Students' portfolios, sailor's logs.
9.	By the end of the school year, the attendance rate for participating students will improve 5% from the previous year.	Mean attendance rate.
10.	By the end of the school year, the percent of fifth grade students', teachers' and parents' positive responses toward school educational programs (computer education, social studies, etc.) will increase by at least 10% from the previous year as measured by the Leon County Attitude Survey.	Objective was modified. Responses of teachers, students and parents were compared with matched schools.
11.	All teachers and media specialists involved in the project will receive training in the use of selected hardware and software as evidenced by a participation log (Captain's log).	Teachers' logs, attendance at training sessions.

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- Teacher's Interview Form - An interview was conducted orally with all teachers in a group. Questions concentrated on feelings toward the project.

- Captain's Log Review Form - This form was a simple checklist of items teachers were to include in their log.

- Classroom Observation Form - This included a checklist as well as open-ended questions for recording classroom instructional characteristics.

February Visit

The purpose of this visit was to assess both the current state of the schools in the project and the changes which occurred since the first visit. Instruments used in this visit were:

- Media Specialist's Interview Form--This instrument asked questions pertaining to the roles of the media specialist.

- Interview Questions for Teachers--The set of questions included the use of various types of media, objectives completed to this point and some feelings regarding the project.

- Captain's Log Review Form--This was a checklist to document progress toward accomplishment of the instructional objectives.

- Classroom Observation Form--See October visit.

- Review Form for Students' Portfolios - This was used to record progress in the development of portfolios.

May Visit

The final visit was the most comprehensive because it was necessary to collect evidence for completion of student products for the summative evaluation report. As before, the following instruments were used.

- School Official's Interview Form

- Survey Questions for Media Specialists

- Survey Questions for Project Teachers

- Captain' Log Review Form

- Review Form for Students's Portfolios

- Classroom Observation Form

2. Student Achievement

Student achievement was assessed through student applications of technology and standardized test scores. Teachers' logs, students' logs and portfolios were used to document the evidence of accomplishment of the products.

The California Achievement Test (CAT) replaced the Comprehensive Assessment Program (CAP) during the Spring of 1992-93. Therefore, a longitudinal evaluation of students' achievements was not possible. Instead, CAT language subtest scores of 5th grade project students were compared with 5th grade students' scores in matched schools using an analysis of covariance design.

3. Student Attendance

Attendance records for 1991-92 and 1992-93 were analyzed to assess improvement in attendance.

4. Attitudes of Students, Teachers, and Parents

The Leon County Attitude Survey was utilized to determine attitudes toward selected aspects of the project. The 1992-93 responses of project fifth grade students, their parents, and fifth grade teachers were compared with their counterparts in ten matched schools.

Summary of Findings by Evaluation Question

Evaluation Questions related to Process

1. **Which technologies (hardware/software) were available in each classroom?**

   All the equipment proposed in the grant was ordered and installed in all project schools but not within the timelines specified in the grant. Bottlenecks for bringing equipment on line caused the completion of hardware installation to be delayed in some cases until the end of the year. Major problems included vendor-related problems (e.g., back order and incorrect shipments), district/state purchasing processes for large technology items, technology decisions required of project schools, and a shortage of district technical support personnel. School networks were not completed until near the end of the 1992-93 school year primarily because wiring was not completed until late in the year. Also installation of classroom telephone lines proved to be a problem due to a district moratorium on telephone lines and back-logged work.

2. **What was the degree of use of the computer workstations, and other media such as videodiscs, LCD, overhead panel, CD-ROMS and telecommunications?**

There was ample evidence from the three evaluation visits that both teachers and students were primary operators of their computers and video equipment. Furthermore, approximately two thirds of the project teachers were applying video discs/VCRs to classroom instruction on a weekly basis by February. In contrast, classroom applications of telecommunications were made by less than half of the project teachers for two reasons. First, there was much to be learned in order to operate the various telecommunications equipment, and teachers were expending much time learning other basic equipment. Second, telecommunications were not operational until the second half of the year.

3. **Did the use of media increase during the school year?**

Yes. According to self-report inventories, computers were already being applied in October in individual or small group settings approximately four hours per week per classroom. This was up from a median of less than one hour per week reported for the previous year when teachers used computers typically for administrative purposes. Stand-alone computers, videodiscs, and VCRs were the most common media applications throughout the year. Baseline survey data indicated that many teachers had never operated any of the sophisticated media before the project began. All in all, considerable progress was made as teachers learned to apply, on a daily basis, Macintosh and IBM 386 technology as well as videodiscs. By the end of the year, some teachers had also experimented with telecommunications and multimedia applications.

4. **Which parts of the grant lack implementation?**

Overall, teachers focussed on accomplishing applications using their computers and videodisc players with individual students or small groups and for large groups with projected images. What was not accomplished in the spirit of the grant by most teachers during the first year was regular applications of multimedia video, telecommunications, and communication through networks. A minority of teachers were experimenting with these applications, but most were actually only achieving mastery of integrating their computers and videodisc players in their social studies curriculum by the end of the year. Also, much of the equipment for multimedia, telecommunications, and network communications did not come on-line in teachers' classrooms until nearly the end of the year or after the year was completed (i.e., video spigot, CD-ROMs, data displays, scanners, networking). The most disappointing characteristic of the first year was the failure to bring networks on line. This virtually eliminated experimentation with telecommunications because telecommunications could only be achieved from within mentor teachers' classrooms and/or media centers. Non-mentor teachers and their students were to be able to telecommunicate through their networks.

5. **How did the technology change the classroom environment and the total school?**

Teachers reported that classroom management and teaching styles by the end of the year were heavily influenced by students working independently and in small groups with project equipment. However, the price being paid was illustrated by the fact that 93% reported that lesson preparation time had increased considerably from the previous year.

School administrators indicated that the project was raising the technological awareness in their school (44%) and project equipment was being shared with other teachers (33%). Furthermore, sixty percent of the media specialists felt that they were becoming more familiar with the state-of-the-art technology and their students were using more technology. All in all, the project was seen as a catalyst to upgrade technology in their schools.

6. **What were the perceptions/feelings toward the project?**

Teachers' feelings seemed to vary as the year progressed but were always positive about the worth of the program. At the end of the year, ratings on a five point scale indicated that teachers considered the project worthwhile (4.8) and enjoyable (4.7). Furthermore, they viewed the project as much less difficult to implement than they did earlier in the year. In fact, nearly all of the project teachers and principals expressed positive feelings about teachers' professional growth and their gain in technological empowerment during the school year. Almost all desired to continue the project during the 1993-94 school year.

Some frustration and anxiety were also evident throughout most of the year mainly because of the uncertain timelines for arrival of the equipment and uncertainty about their own abilities to deal with specific applications.

7. **Were the teachers being able to complete the goals/objectives of the grant?**

Results of the evaluation visits indicate that project teachers were able to accomplish the majority of their instructional objectives but not necessarILy using the suggested media activities nor within the timelines specified in the grant proposal. Because of delays in equipment arrivals, the project actually began several months behind the schedule listed in the grant proposal. As a group, project teachers completed approximately 66% of their preselected objectives by the May visit. Approximately two-thirds of the incomplete objectives were accounted for by instructional strategies requiring the use of telecommunications or multimedia equipment. (See Table 3 for a listing of school-selected objectives). Furthermore, some teachers at every school completed instructional objectives other than those which were pre-selected by their school.

8. Was the amount of training sufficient to incorporate appropriately the technology in the classroom?

Teachers received at least the 44 hours of training stated in the grant, although the specific topics were changed to reflect the needs of the teachers. Much more training was conducted in computing basics and curriculum enhancement than was stated in the grant proposal, and less training was conducted on the more advanced topics. The issue concerning training was not necessarily the amount, although it is never enough, but the timing of training. Sometimes training occurred well before the arrival of equipment. By the time the equipment arrived teachers had often already forgotten what they learned. Nevertheless, during interviews, teachers felt positive about the training provided to them by the grant but believed that more follow-up training was needed.

Evaluation Questions related to Outcomes

9. To what extent were the student outcomes achieved?

Many classroom applications of technology were accomplished by project teachers and students even though the evaluation of product outcomes yielded mixed results. The project definitely achieved the expected outcomes for two products involving E-Mail and/or Fax (See Table 2, outcomes 3 and 6). Two more product outcomes involving Timeliner software and posters (2 and 5) might have been achieved, however, this was not truly determined because the quality of teachers record-keeping for student products varied considerably. (In fact, thirteen of the project teachers simply did not maintain portfolios, therefore the scope of students' products were not accurately documented.) The project did not achieve its expected outcome of students contributing work to a graphic slide show. The activities associated with this outcome required the use of more complex technology and probably required more time than teachers were able to assign to them.

The evaluation yielded no evidence that language skills of students improved as a result of the project. Comparisons of project students' CAP subtest scores with those of students of matched schools yielded no significant differences in language arts achievement when adjusted by a covariate of prior year CAP language scores. These results conform with the literature in the field. Student achievement as measured by standardized tests may be an important measure of the success of an educational program but improvement in test scores may take multiple academic years to occur. In addition, many standardized tests are not yet sensitive to the skills in which technology develops. An achievement test may not reflect improvements in achievement when they in fact exist.

Table 3
Completion of School-Selected Objectives by at Least 50% of Teachers Before February/May Visits by School

School\Obj	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3*	2.4	2.5*	3.1	3.2	3.3	3.4	3.5*
1	Feb							May		N					May
2	Feb				N			N	N	N	N				N
3			Feb					May		N					N
4			May					May		N					N
5	May				Feb			May		May	May				May
6	Feb					Feb		Feb		May	May				May
7	May							May		May					May
8		May						Feb		N	N				N
9	Feb							May		May					May
10	Feb					Feb		Feb		Feb	May				May
Compl. Date	Oct	Oct	Nov	Dec	Dec	Feb	Mar	Mar	Mar	Mar	May	May	May	May	May

N = Objective was selected by school but not accomplished by at least 50% of the teachers before the May visit.

1.1 Students will have knowledge of Columbus and other explorers and pioneers.
1.2 Students will have knowledge of the "Old World"—its geography, cultures, and politics.
1.3 Students will have knowledge of early technology and its uses.
1.4 Students will have knowledge of early forms of communications.
1.5 Simulate the voyage of Columbus.
2.1 Students will have knowledge of modern day explorers.
2.2 Students will have knowledge of today's changing world.
2.3 Students will have knowledge of today's technology and its uses.
2.4 Students will have knowledge of today's forms of communication.
2.5 Simulate a modern day exploration.
3.1 Students will predict future frontiers to be explored.
3.2 Students will predict future political and cultural structures.
3.3 Students will predict and design new forms of technology to solve future problems.
3.4 Students will predict future forms of communication.
3.5 Students will envision a future exploration.

Actual counts of objectives accomplished and media used are treated in Tables 2.4, 2.5, and 2.6.
*Mandatory objective—to have been completed by all project teachers.

10. Was there a change in the level of student involvement in the school as measured by attendance data?

The project did not improve the attendance rate of the students as a whole. The mean absentee rate was approximately 3.6% for both the 1992-93 project year and the prior year. This translated into less than 6.5 days per 180 day period. The question is formulated whether any project should be expected to generate enough excitement in elementary students to significantly decrease an absentee rate which is so small?

11. Are the attitudes of students, parents and teachers more positive than their counterparts in matched schools?

Overall, the data did not indicate project students' attitudes were more positive than their peers in matched schools as measured by the Leon County School Attitude Survey. The exception was media and library services where the mean project student's response was 10% more positive. Most of the project parents responses showed a more favorable attitude toward their schools overall than those of matched-group parents.

Project teachers' mean responses for the four questions evaluated were higher than those of matched teachers. For media and library services, the difference was found to be more than 10%.

Caution is advised when considering these results. The survey was not especially designed to assess attitudes of project stakeholders. Furthermore, comparisons of project schools responses were made with those of matched schools without the benefit of a covariate to adjust for initial group differences because data was not collected which allowed grade levels to be identified.

Overall, feedback from teachers and principals indicated that substantial positive feelings were created about technology and its worth to education in the project schools (see question 6).

12. What were the major benefits associated with the project?

Some of the highlights are:

- Almost all project teachers and most students learned to use and frequently applied later generation MacIntosh and DOS desktop computers to classroom instruction.
- Approximately two-thirds of the project teachers were applying video discs/VCRs to classroom instruction on a weekly basis by February. A minority of project teachers began experimenting with telecommunications applications during the second semester.
- The technology put into place exceeded the existing technology in both quantity per classroom and quality.
- The district staff and ten schools learned much and collected much information about equipment availability, compatibility and the resources and coordination required to bring schools on line.
- Substantial positive feelings were created about technology and its worth to education.

- The project served as a catalyst for teachers to work with each other, district staff, their school administrators, and their media specialists to solve technical problems and plan social studies lessons.

- The schools gained valuable experience in the implementation of multiple technologies in the classroom, experience that is worth sharing. The sharing of information and experiences can help staff try new approaches to teaching.

- Most project teachers received more media training than had been received by most other teachers in their schools, thereby, providing their school with a larger nucleus for preparing technology plans and training other teachers.

- Overall, the project conveyed the belief that technology can be used to improve classroom instruction but technology alone is insufficient to accomplish this. Many other changes will be necessary, including a fundamental change in instruction and learning methods.

Conclusions and Recommendations

In reviewing the above findings, it is evident that the scope of the technological applications proposed for the project classrooms was excessive given the timelines. The implementation of the proposed plan might be best characterized as an attempt to pack a multi-year project into one year. Formative evaluation reports revealed holdups in equipment delivery which caused the completion of hardware installation to be delayed until the end of the year and subsequently affected the full implementation of the project. Also training sometimes occurred well after or well before equipment was operational in the schools, causing additional frustrations.

The test score data did not show major difference in achievement. This was hardly surprising since the relationship between the skills promoted by the technology and the tests utilized were unclear, and further, because improvement in test scores may take multiple academic years to occur. Fortunately, the students' products and portfolios yielded rich data although they proved to be difficult to evaluate.

Despite the difficulties experienced throughout the first year, there was abundant evidence of major accomplishments, and schools, teachers, and students appeared to have benefitted significantly. Reports by school staff revealed that by the end of the year teachers were just reaching the stage where they were prepared to implement the project in the spirit of the grant. Although the project received no direct second year funding from the DOE, a small amount of grant and other resources were granted by the district for teacher training and evaluation.

In light of the foregoing, the following recommendations are offered.

- **Media-rich programs should be envisioned as multi-year projects with modest goals for implementing equipment and training in an orderly fashion during the first year.** Experience from this project indicates that modest amounts of media should be put into classrooms in an orderly process beginning with computers and videodiscs. Other media should be added when most of the teachers have been trained and have demonstrated their ability to apply preliminary equipment.

- **Funding agencies should consider supporting three year studies of technology projects.** The first two years should focus on process variables and the third year should continue documentation of the process as well as assessments of the effectiveness of the project according to a variety of indicators.

- **Expected outcomes for project teachers and students should be stated in terms of empowerment and should be evaluated in a systematic manner that is not totally dependent on teachers' logs and students' portfolios and products.** Expected outcomes should be stated in terms of teacher and student empowerment. Empowerment implies not only what skills have been performed, but, also, what the subjects are enabled to do as a result of having learned the skills.

- **Technicians representing all pertinent areas and who are knowledgeable with the physical attributes and equipment of the targeted facilities should be consulted on a regular basis in planning the technology designs and timelines of the project.** In the post project debriefing of the project technicians and manager, the technicians pointed out that most of the technical bottlenecks could have been either planned for or avoided if technicians had been more involved and consulted during the writing of the grant.

- **Training in the utilization of software and hardware should be "just in time". If possible, it should be delayed until the equipment is in place.** As previously indicated, the timing of the training was crucial for the appropriate utilization of the equipment. The lag between training and complete hardware installation diminished the value of training.

- **Funding agencies should ensure a genuine commitment to effective evaluation so that sound decisions can be made about the program being evaluated.** One of the positive aspects of this project has been the evaluation team's ongoing support of the project. Formative evaluation should begin when program planning begins and should continue through program implementation until it is time for summative evaluation.

- **More detailed investigations are needed related to whether educational technology has a significant role to play in bringing substantial improvements to both teaching and learning.**

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